manding presence, and the extent over which his utterances were heard, marking him out as the Arago and Brewster of Germany. Germany showered on him in profusion those honours and offices which it gracefully and gratefully bestows on learning and science; and perhaps there is no learned or scientific society of any note that has not the name of Dove enrolled among its honorary members. After a protracted and hopeless illness he died on Sunday last, April 6, in the seventy-sixth year of his age.

In the Royal Society's Catalogue of scientific papers, the lists under Dove specify 234 memoirs written between the years 1827-73. These show him to have been a successful worker and investigator in electricity, optics, crystallography, and in such practical matters as measures and the art of measuring, or the metric system of civilised nations. But it was to meteorological inquiries he devoted his full strength and all the powers of his mind, and, by his herculean but well-directed labours he has written his name in large imperishable characters on the records of science.

His fame rests on the successful inquiries he carried out with a view to the discovery of the laws regulating atmospheric phenomena which apparently are under no law whatever. The work he will be long best known by is his isothermals and isabnormals of temperature for the globe, in which work one cannot sufficiently admire the breadth of view which sustained and animated him as an explorer during the long toilsome years spent in its preparation. Equally characterised by breadth of view, and what really seemed a love for the drudgery of detail even to profuseness when such drudgery appeared necessary or desirable in attaining his object, are his various works on winds, the manner of their veering and their relations to atmospheric pressure, temperature, humidity, and rainfall, and the important bearings of the results on the climatologies of the globe; on storms and their connections with the general circulation of the atmosphere; the influence of the variations of temperature on the development of plants; and the cold weather of May—to which may be added the valuable system of meteorological observations he gradually organised for Germany, and the many full discussions of these which he published from year to year.

It is no small praise to pass on his work to say that those views he propounded, which subsequent researches are likely to modify materially, are those he arrived at by methods of investigation necessarily defective at the time. Thus, for instance, in inquiring into the law of storms, it was not in his power to work from isobaric charts, seeing that the errors of the barometer and their heights above the sea were known in but few cases. When we consider the condition in which he found man's knowledge of weather and the large accessions and developments it received from his hand, the breadth of his views on all matters connected with the science and the well-directed patience, rising into high genius, with which his meteorological researches were pursued, there can be only one opinion, that these give Dove claims, which no other meteorologist can compete with, to be styled "the Father of Meteorology."

THE INSTITUTION OF NAVAL ARCHITECTS

THE twentieth session of the Institution of Naval Architects has now been brought to a close. The meeting, with Lord Hampton in the chair, was held at the house of the Society of Arts, John Street, Adelphi, and was well attended throughout. One of the latest developments in ship-building is shown in the paper on "The Structural Arrangements and Proportions of H.M.S. *Iris*," by W. H. White, Assistant-Constructor of the Navy. The construction of the *Iris* marks a new era in the British Navy, being the first vessel built wholly of steel; she is an unarmoured dispatch vessel, specially designed for high speed and great coal endurance. Her principal dimensions are: length between perpendiculars, 300 feet, breadth, extreme, 46 feet, mean load draught, 19 feet 9 inches, displacement, 3,735 tons.

Special attention has been paid to resistance to torpedo attack by constructing the hold in twenty-one separate compartments and the double bottom and bunkers in forty; with the additional weight thus introduced, it is still found that there is a saving of weight in the hull by the use throughout of steel amounting to 12 per cent., or 175 tons. The engines take 28 per cent of the displacement, and 20 per cent. is available for coal, which is estimated to be sufficient for steaming 7,000 knots at a speed of 10 knots per hour. The speed attained by the *Iris* on the measured mile was 18·6 knots, with an expenditure of 2·3 indicated horse-power per ton of displacement as compared with 14 indicated horse-power, required by a torpedo vessel.

In striking contrast with the *Iris* we have the monster proposed by Rear-Admiral J. H. Selwyn in his paper "On the most Powerful Ironclad." The author of the paper has long advocated some modification of the circular ironclad first proposed by Mr. Elder some years ago, and carried out with some alterations by Admiral Popoff. The vessel here proposed is 370 feet in length 220 feet in breadth, with a draught forward of 18 feet and aft 13 feet. Her armament is to consist of twenty 80-ton guns, or eight 100-ton and eight 80-ton; these are to be mounted in two gun-pits on the Moncrieff hydro-pneumatic principle. The guns are carried on a turn-table of the full size of each gun-pit, the floors of which are composed of steel bars set on edge to provide for ventilation, but to keep out shell fragments; the breast-work round each will consist of 30 inches of armour-plating. The guns would be raised by hydraulic power to fire over the breast-work, recoiling automatically under cover for re-loading. The vessel would be protected with a belt of 30-inch armour round the water-line, and a thickness of 25 feet of coals stowed inside it. There would be two Perkins hydraulic engines of 21,000 horse-power for propulsion and steering, and these would be at once available for keeping the vessel afloat in case of a leak. The author estimates that if a hole 10 feet square were made by a torpedo, the engines would be able to keep the water under, while danger of sinking by such damage is much lessened, if the engines are partially disabled, by the large number of water-tight compartments. It cannot be denied that the Russian Popoffkas have been far from successful, especially in facility of steerage, which was one of the main advantages claimed for them, but it can only be determined by an actual experiment whether our naval authorities can overcome the difficulties in speed and steering which have baffled the Russian Admiralty. Even if a vessel as here proposed could not be made sea-going, or to attain a 16-knots speed as claimed, she would at least be more valuable as a harbour defence than a Spithead or Plymouth breakwater fort, and could be adapted to some sites at a less cost in proportion to the weight of armament.

"Armour for ships" by Mr. Barnaby, C.B, Director of Naval Construction, consists of a general review of the progress of armour-plating from its introduction in 1854 down to the present time. The description of the steel turret-plates manufactured by Messrs. Schneider at Creuzot, 32 inches thick, and weighing 65 tons, is not without significance in the present state of depression in the iron trade of this country, but some consolation is to be obtained from the account given of the steel-faced plates of Messrs. Brown and Cammell which shows that some progress is still being made nearer home. The paper by Admiral Sir R. Spencer Robinson, K.C.B.,

F.R.S., gives an exhaustive statement of the experiments that have been made on various targets at Shoeburyness, representing the armour of different ships. A table is given showing the displacement, thickness of armour, and proportion of the former to the latter in ships of different types; this ratio varies from 6·38 in the *Warrior*, 4·00 in the *Alexandra*, to 2·95 in the *Dreadnought*, and 2·50 in the *Glatton;* thus the last may be considered the most heavily-armoured vessel in proportion to size in the navy. The penetration of shot of different diameters and weights with various velocities is given, and the experiments show that it is proportional to the energy of the shot on impact whether due more to velocity or weight, and inversely proportional to diameter of shot; also that the resistance of solid plates is proportional to the square of their thickness. The resistance of composite targets is treated at some length, and a comparison drawn between the various forms adopted in existing ships and the Millwall shield designed by Mr. Hughes, in which the latter is shown to be preferable; but the questions of steel and steel-faced armour which are now attracting the attention of artillerists are not gone into, and are only referred to with the evident feeling that the end of the battle between guns and armour has not yet come.

The paper "On the Resistance given to Screw-Ships by the Action of the Screw-Propeller, and how to Remedy it," by Robert Griffiths, points out an important difficulty in screw-propulsion which has only recently been recognised. A screw-propeller obtains the resistance to drive the ship forward by accelerating the velocity of the currents of water flowing past the stern of the vessel; as in different parts of the screw's disk these currents are encountered at different velocities, the resistance to a blade is not uniform throughout a revolution. In experiments made at Devonport by towing a screw-pinnace, it was found that the water flowed through the lower half of the screw disk nearly at the speed at which the boat was towed, but in the upper half it was so dragged by the boat as to flow past the screw at only half that speed. In dynamometer diagrams, taken with H.M.S. *Rattler*, it was shown that the thrust of the screw varied from 2·9 to 4·1 tons in each revolution. The increase in the resistance of the ship, due to the working of the screw above that due to the ship herself when towed at the same speed, and which Mr. Froude has shown to be 40 or 50 per cent., is considerably greater when the upper currents are more accelerated than it would be if the acceleration were uniformly given to the whole column of water passed through by the screw disk. The author proposes a screw-propeller so constructed that the blades always meet with equal resistance. The blades are so made that more than half their surface is aft of the centre line, so that the pressure on their surface tends to lessen the pitch; they are also made movable in the boss, but so connected that by decreasing the pitch of one, that of the other is increased; when, therefore, one blade meets with more resistance than the other, the increased pressure causes it to turn and throw some of the work on the other.

In his paper on naval guns, Mr. C. W. Merrifield vigorously attacks the Woolwich type of gun, pointing out the disadvantages and absolute futility of the increasing twist in rifling at present adopted. It is now four or five years since this was first done by Prof. Osborne Reynolds, and, aided by the *Thunderer* explosion, it is to be hoped that the time is drawing near when the subject will receive the consideration of the War Department. The author also lays great stress on the advantages of breech-loaders over muzzle-loaders, regarding the latter now, with its complication of gear and fittings, as inferior to the former, even in the simplicity always claimed for it.

Amongst other papers read at the meeting are the following:—"On Sir William Thomson's Navigational Sounding Machine," by P. M. Swan, in which the accuracy of this now well-known apparatus is amply testified by a large number of observations; and a paper by Mr. J. Scott Russell, F.R.S., "On the true Nature of the Wave of Translation, and the Part it plays in Removing the Water out of the Way of a Ship with least Resistance."

OUR ASTRONOMICAL COLUMN

NOTE ON 72 OPHIUCHI (O. Σ. 342).—The publication of the entire series of observations of this suspected double star, made at Pulkowa to 1876, does not lessen the difficulty of arriving at a definite conclusion as to its duplicity or otherwise. On November 1, 1841, it was noted double magnitudes 4 and 7 on Struve's scale, and, no doubt attached to the observation; on May 14, 1842, it appeared single, but at the epoch 1842·72 it was again double, the measures giving for position, 156°·6, and distance, 1″·3. Subsequent observations gave the following results:—

1844·85	...	Single, or with only a suspicion of elongation at 63°; images excellent.
1845·62	...	With very good images; no companion seen.
1846·49	...	Single, or perhaps slightly wedged at 87°.
1847·50	...	Pos. 162°·4, dist. 1″·61, but there was a doubt if the object observed was not an optical illusion.
1847·70	...	Pos. 168°·1, dist. 1″·6. M. Struve says: "I feel sure of the duplicity, but the images are not very good."
1848·79 1850·50 1851·51	...	Single.
1851·67	...	Pos. 166°·3, dist. 1″·49. After the observation a note was added—"This is only an optical deception."
1852·63	...	Single; under excellent atmospheric conditions.

This last observation appearing decisive, M. Struve considered that 72 Ophiuchi should be omitted from the list of double-stars, and in the following years only examined it once (1859·66), when it was again single under very favourable conditions. But in 1876 he found reason to modify his view: at 1876·67 the satellite was seen very distinctly, with position 156°·0, distance 1″·60; a fortnight later there were only very slight impressions of a satellite, and M. Struve remarked that the principal star of 70 Ophiuchi presented an analogous phenomenon, though less distinctly. Hence arose the suspicion that the said impressions were caused by accidental conditions of the air and the instrument. Nevertheless, on considering the preceding observations and the fact of their being made without the least recollection of anterior ones, M. Struve thinks their approximate agreement cannot be attributed to chance, and that we are necessarily led to infer that the star is really double, but the companion undergoes considerable and rapid variation of brightness. It is worthy of note that only three weeks before the Pulkowa observation of 1859, when the star was pronounced single, Secchi had recorded of it: "Certainly double, and well separated," his measures giving the position 3°·75, distance 0″·61.

THE VARIABLE STAR χ CYGNI.—According to the later observations of Dr. Julius Schmidt at Athens, it is probable that the next maximum may occur on or about April 25, and the next minimum about December 14. At the last observed maximum on March 14, 1878, the star was hardly a fifth magnitude, which is about the mean brightness in that phase, the extreme limits of variation being two magnitudes or 4m.—6m. according to Prof. Schönfeld; at minimum it descends to 13m. No formula has yet been deduced which will represent satisfactorily the totality of the observations, commencing with those of Kirch the discoverer in 1686; considerable